

OCTOBER 2019



**WIM #37
I-94, MP 200.1
OTSEGO, MN**

**MONTHLY
REPORT**



Your Destination...Our Priority



WIM Site Location

WIM #37 is located on I-94 near Otsego in Wright county. The WIM is located only on the westbound (WB) side of I-94, meaning that all data mentioned in this report pertains to WB traffic only (Lanes 1 and 2).

System Operation

WIM #37 was operational for the entire month of October 2019. Volume was computed using all monthly data.

System Calibration

WIM #37 was most recently calibrated on 2016-08-01. Table 1 summarizes the front axle weights of class 9s by lane ¹. Figure 1 shows the distribution of gross vehicle weights (GVW) in the Class 9s at this site for the last 12 months ². Figure 2 depicts the average front axle weight as a percent difference from the first full month following calibration.

Summary of Volume Statistics

Total Monthly Volume: 1016074 | Passenger Vehicles: 865184 | Heavy Commercial Vehicles: 150890

Monthly Average Daily Traffic (MADT): 32777 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 4867

See Table 2 for vehicle class breakdown

Passenger Vehicles (PVs) and Heavy Commercial Vehicles (HCVs)

Volume trends. WB vehicles typically reached highest volume levels on Fridays, with lowest volumes reported on Mondays (see Figure 3 and 4).

Passenger Vehicles (PVs)

Volume trends. On an average 24-hour day (see Figure 5), WB PVs generally reached peak volume levels between 03 PM and 05 PM.

Heavy Commercial Vehicles (HCVs)

Volume trends. On an average 24-hour day, HCVs traveling WB typically reached peak volume levels between 03 PM and 05 PM. See Figure 6. Out of all HCVs, the two highest traffic volumes were generated by Class 9's and Class 5's.

Overweight HCVs

Volume trends. Of a total of 150890 HCVs, 15774 of them were overweight ³. These overweight HCVs contributed to 1.2% of total monthly volume, and 8% of total monthly HCV volume. WB overweight vehicles typically reached highest numbers on Thursdays, with lowest volumes reported on Sundays See Figure 3 .

The top two overweight violators by class were the class 9 and class 14 vehicles . Overall, overweight vehicles tended to reach peak volume concentrations during typical business hours (see Figure 7 & 8).

Figure 9 shows the number of vehicles exceeding 88,000 pounds that crossed the WIM over the last 12 months. The highest number of 88,000+ vehicles within the last 12 months occurred in October.

WIMs are currently used as a screening tool for weight enforcement, and it is estimated that the WIM scales can measure gross vehicle weights (GVW) within 90-95% of static weight scale measurements. Due to the possibility of measurement error, vehicles exceeding 10% of their legal weight limits (or 1.1 times their legal weight limits) are considered overweight in this report ⁴.

Using normal load limits ,3313 WB vehicles exceeded 88,000 pounds (2445 vehicles were Class 9's; 422 vehicles were Class 10's). Refer to Table 3 for the Top 10 highest recorded GVWs from Classes 9 and 10 from October 2019.

Loaded vs. Unloaded HCVs. Figure 10 shows the GVW distributions of Class 9's and 10's in October 2019. Data suggests that there were greater numbers of fully_loaded Class 9's than empty Class 9's traveling WB Data also suggests that there were more NA Class 10's than NA traveling in the WB direction.

Freight Totals. A total of 1670063 tons of freight was recorded to have crossed the WIM. See Table 4 and Figure 11 for more freight information.

#####Infrastructure Considerations Bridge. Bridge No. 86817 is approximately 1.2 miles east of WIM #37 and Bridge No. 86813 is approximately 4.7 miles west of WIM #37. WIM #37 recorded a total of 1016074 vehicles with a combined GVW of 14543489 kips (1 kip = 1,000 pounds = 0.5 tons) in October 2019. See Table 5 and Figures 12-13 for GVW information by vehicle class and lane.

Pavement Design. A total of 478346 equivalent single axle loads (ESALs) passed over the pavement at this site. In particular, 69% of all ESALs were generated by the Class 14's (Class 14's were also responsible for generating % of total GVW observed this month). See Table 6 and Figures 14-15 for more information on ESALs (Table 6 also provides flexible ESAL factors for each vehicle class using a terminal serviceability of 2.5 and a structural number of 5).

#####WIM monthly reports can be found at:

<http://www.dot.state.mn.us/traffic/data/reports-monthly-wim.html> MnDOT's vehicle classification scheme and vehicle class groupings for traffic forecasting can be found at: <http://www.dot.state.mn.us/traffic/data/data-products.html#weight>

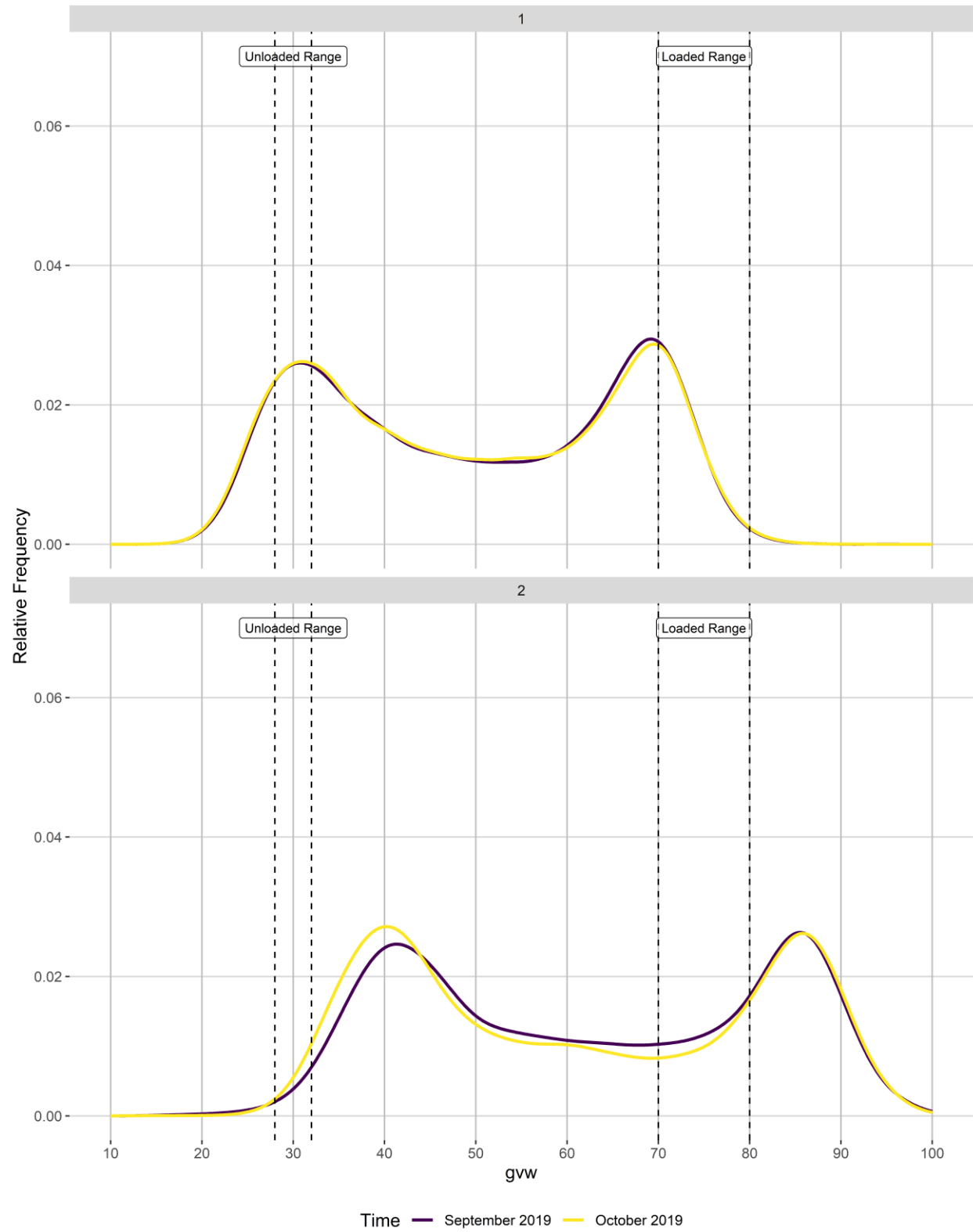
- ¹ Front axle weights of Class 9s are monitored on a monthly basis to assure performance between calibrations. The current goal of the WIM scale calibration is to have each individual axle weight stay within a range of +/-9% of baseline calibration values
- ² Previous WIM research indicates that unloaded Class 9s typically weigh 28-32 kips, while loaded Class 9s generally fall in the 70-80 kip range. More recent data from

several WIM sites suggests that the unloaded Class 9 range may have moved a little higher over time (due to increased presence of sleeper cabs, etc.), although these ranges are also thought to be site-specific.

- ³ An HCV is considered overweight during normal load limits in this report if they satisfy any of the following 1) exceed a gross vehicle weight (GVW) of 80,000 pounds, 2) exceed any of the legal weight maximums on any axle configurations (legal maximums are: single axle = 20,000 pounds; tandem axles spaced 8' or less = 34,000 pounds; tridem axles spaced 9' or less = 43,000 pounds; quad axles spaced 13' or less = 51,000 pounds). Monthly reports use this standard regardless of the time of year however, the Winter Load Increase (WLI) allows a 10% across the board increase in axle and gross vehicle weights without a permit on US, state routes, and county roads. An HCV is considered overweight during Winter Load Increase(WLI) if they satisfy any of the following 1) exceed a gross vehicle weight (GVW) of 88,000 pounds, 2) exceed any of the legal weight maximums on any axle configurations (legal maximums are: single axle = 22,000 pounds; tandem axles spaced 8' or less = 37,400 pounds; tridem axles spaced 9' or less = 47,300 pounds; quad axles spaced 13' or less = 56,100 pounds). An overweight HCV is only included once in the overweight volume calculations regardless of how many of the aforementioned conditions are violated. For information on MN weight limit dates and statutes:
http://www.mrr.dot.state.mn.us/research/seasonal_load_limits/sllindex.asp
- ⁴ For example, Class 9s and 10s can legally have gross vehicle weights up to 80,000 lbs (with the exception of permitted loads) during normal load limits. To account for measurement error on the WIM scales, those exceeding 10% of the legal GVW maximum (or 1.1 times the legal GVW) should be screened (e.g., 80,000 lbs + 8,000 lbs = 88,000 lbs). Similarly during WLI vehicles weighing 96,800 lbs should be screened.

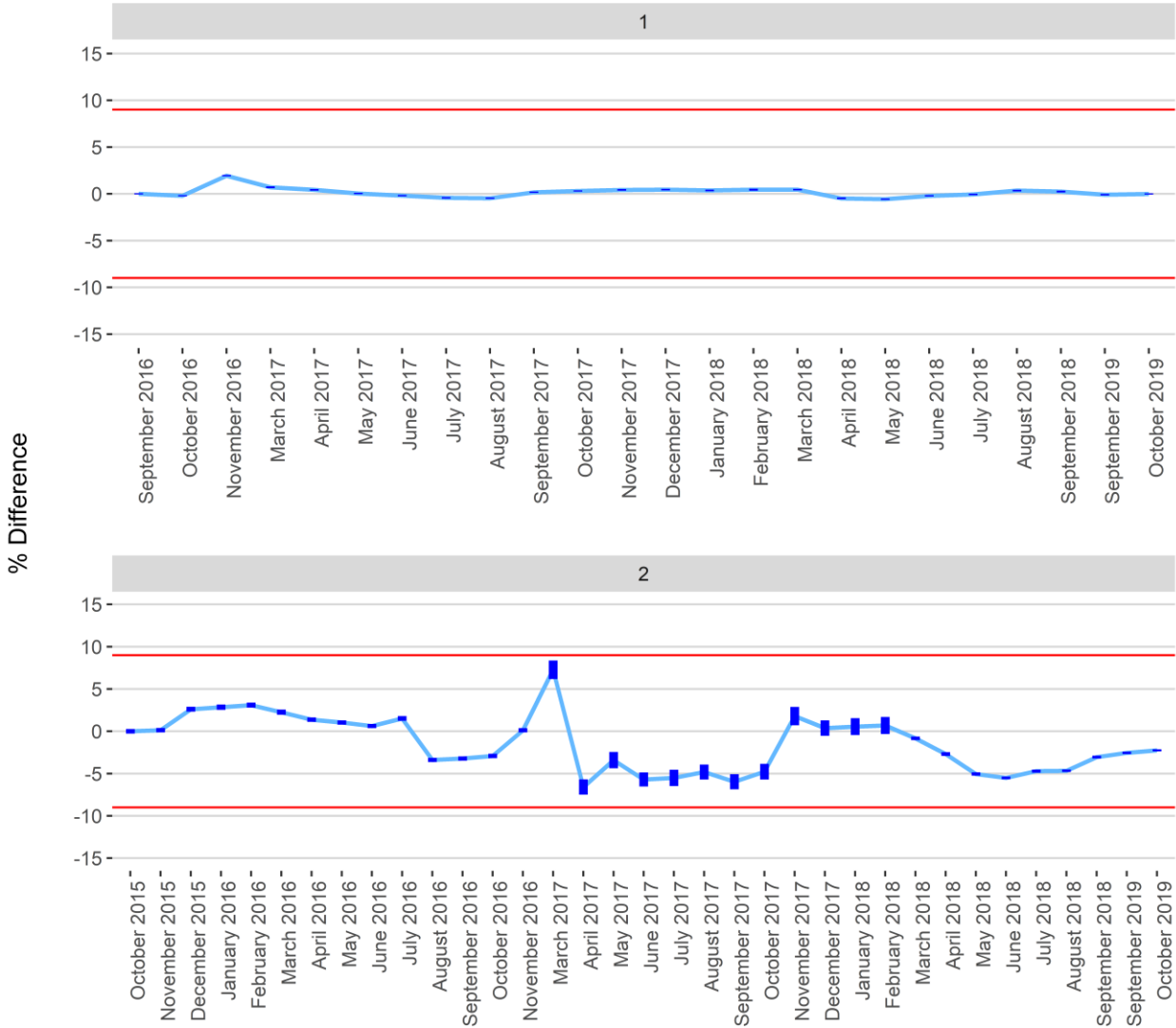
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Figure 1 - Monthly Class 9 GVW Histogram



Months that have not passed QC parameters are not displayed

Figure 2 - Percent Difference of Front Axle Weight from Last Calibration (+/- 95% CI)



Months that have not passed QC parameters are not displayed

Figure 2 - Average Vehicle Volume
vs. Day of the Week

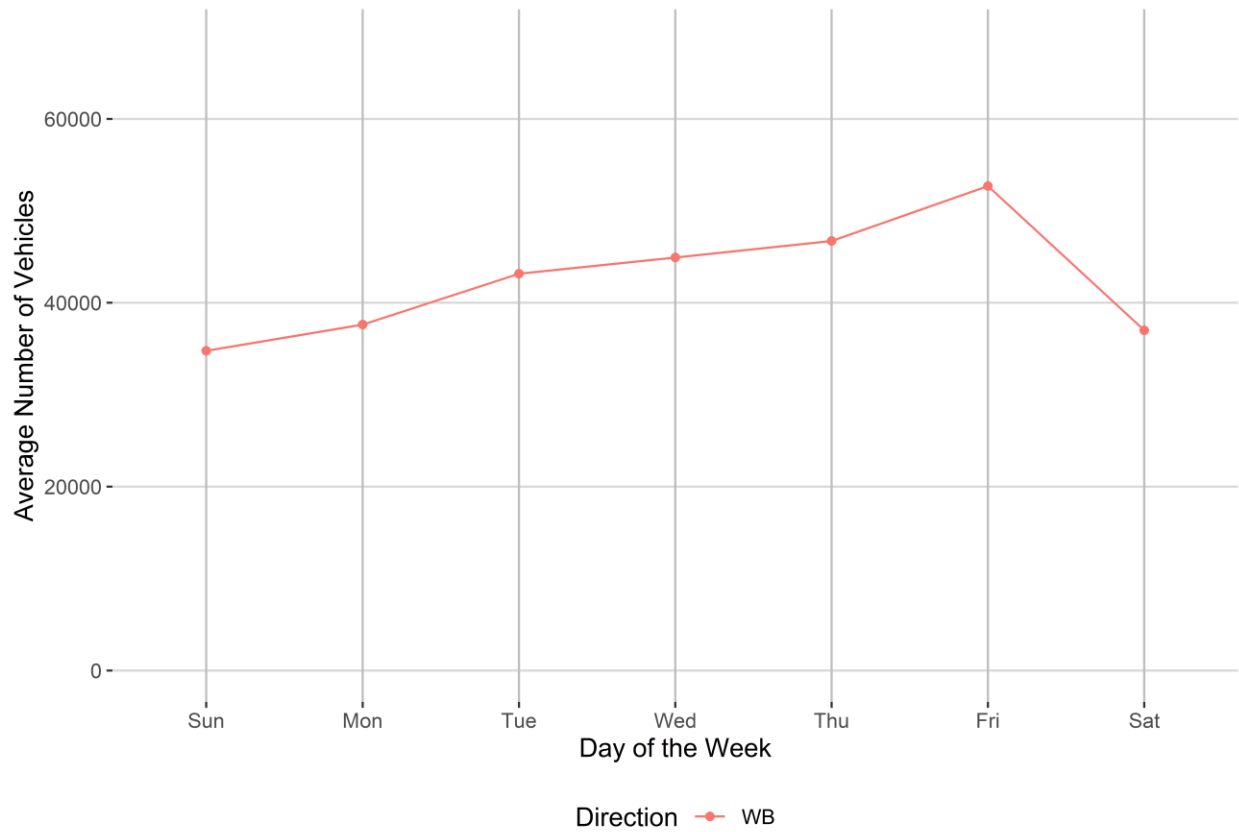


Figure 3 - Average Overweight Vehicle Volume
vs. Day of the Week

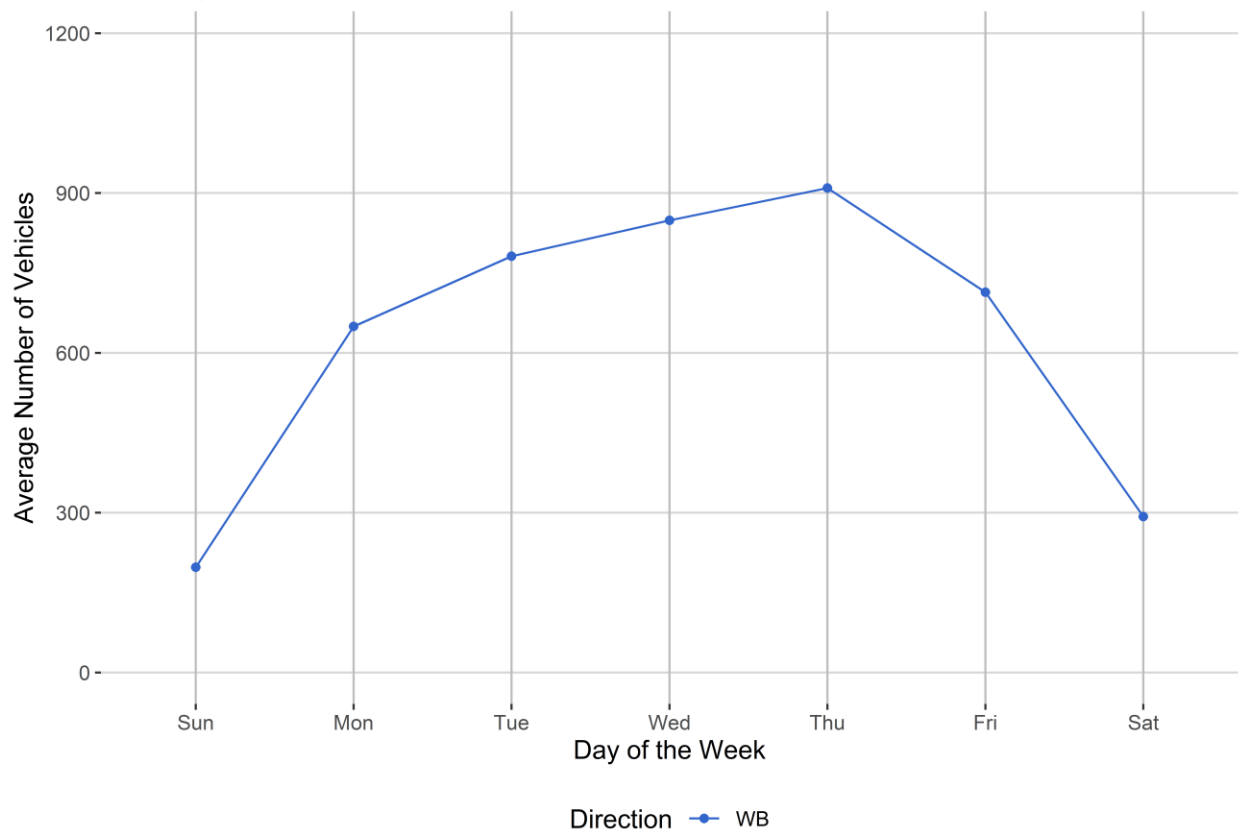


Figure 4 - Passenger Vehicles
vs. Hour of the Day

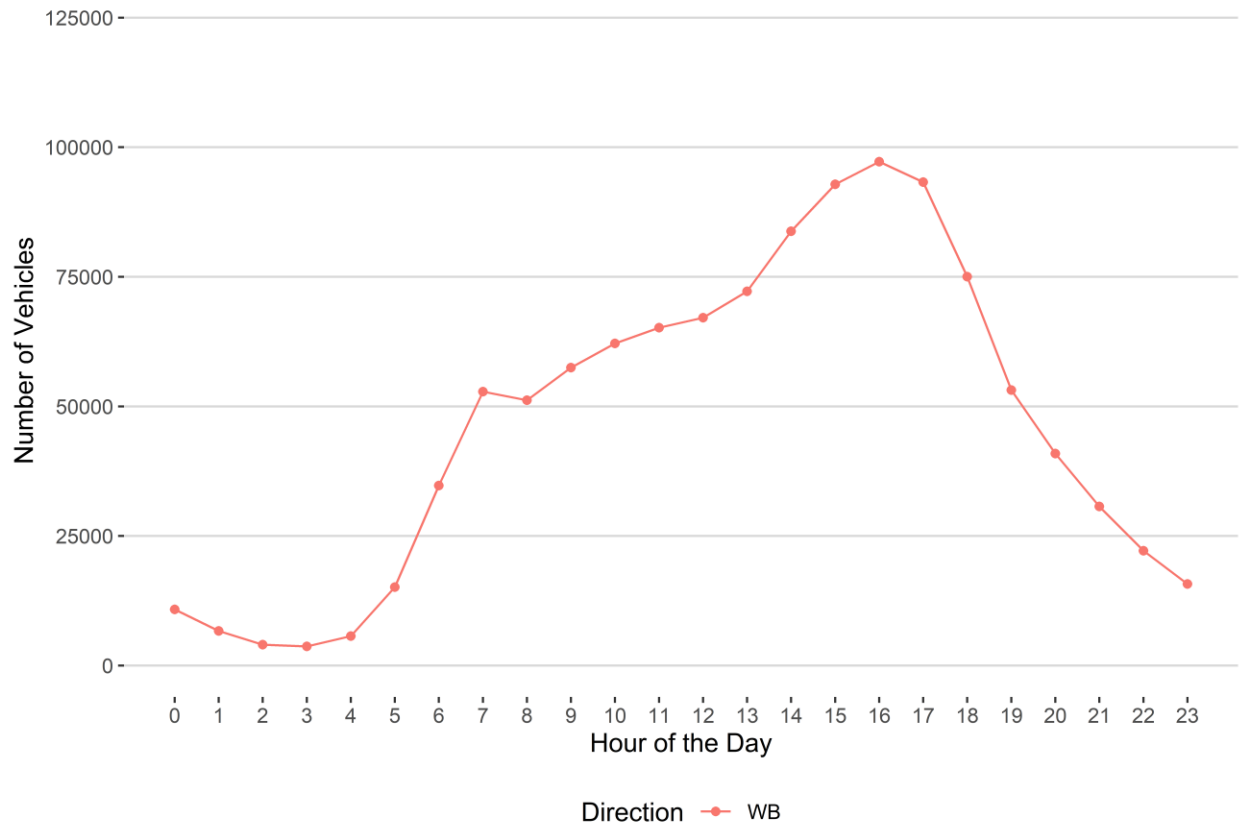


Figure 5 - Heavy Commercial Vehicles
vs. Hour of the Day

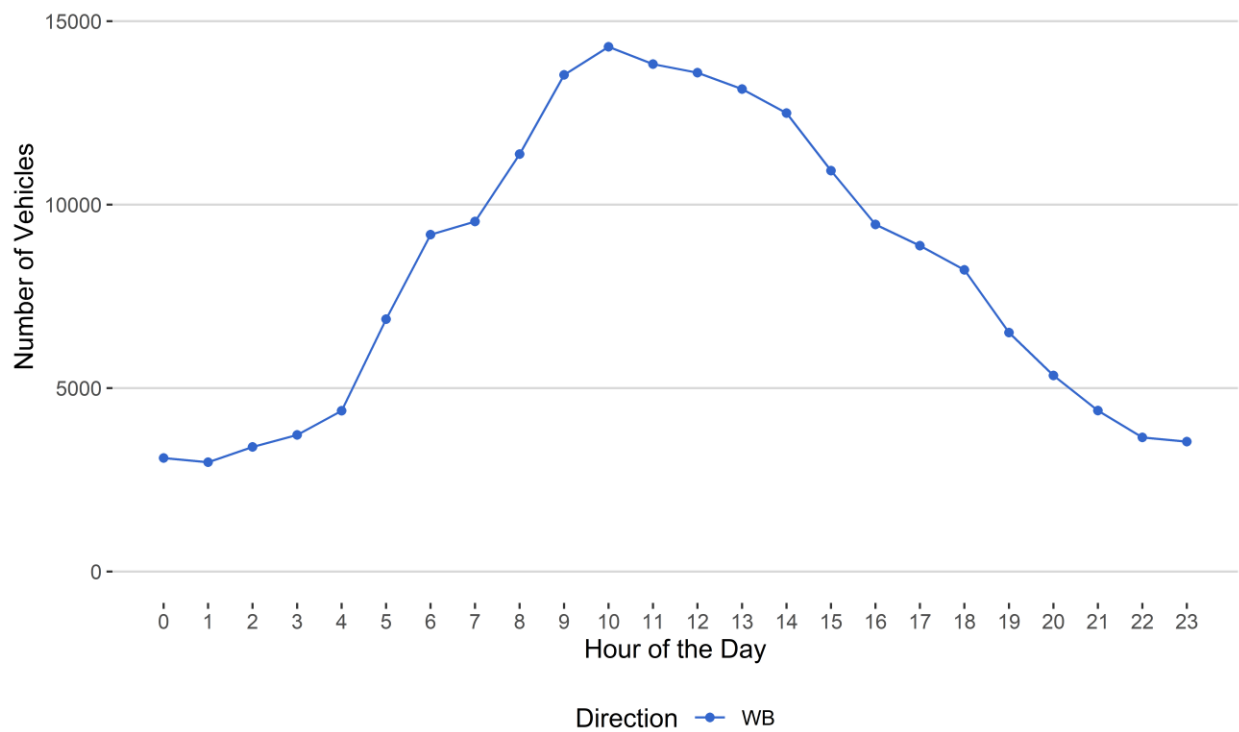


Figure 6 - Overweight Vehicles by Class
vs. Hour of the Day

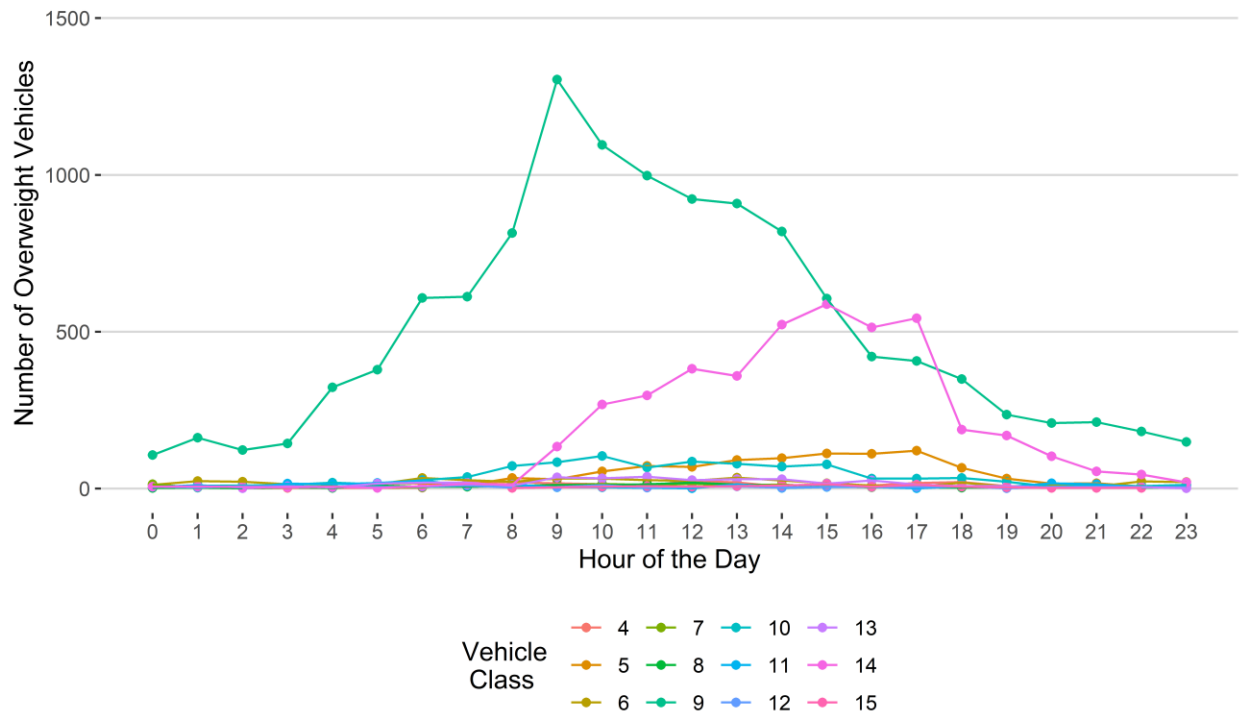


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

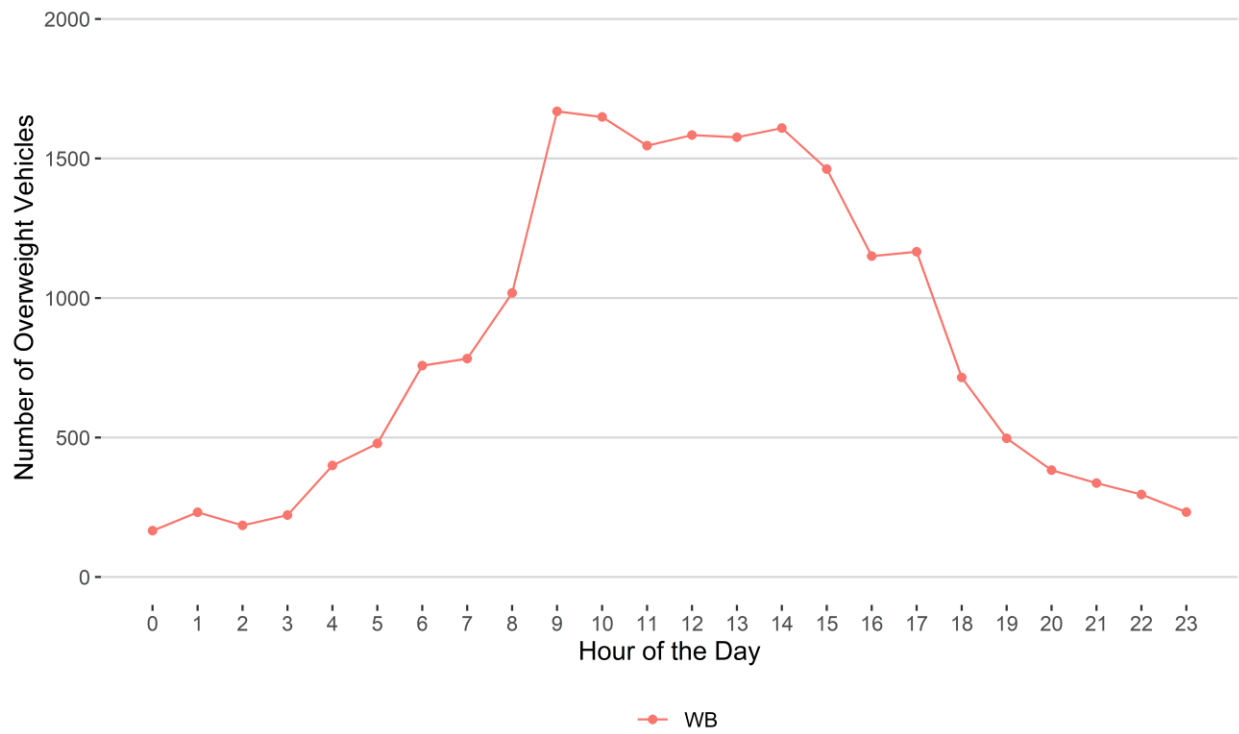
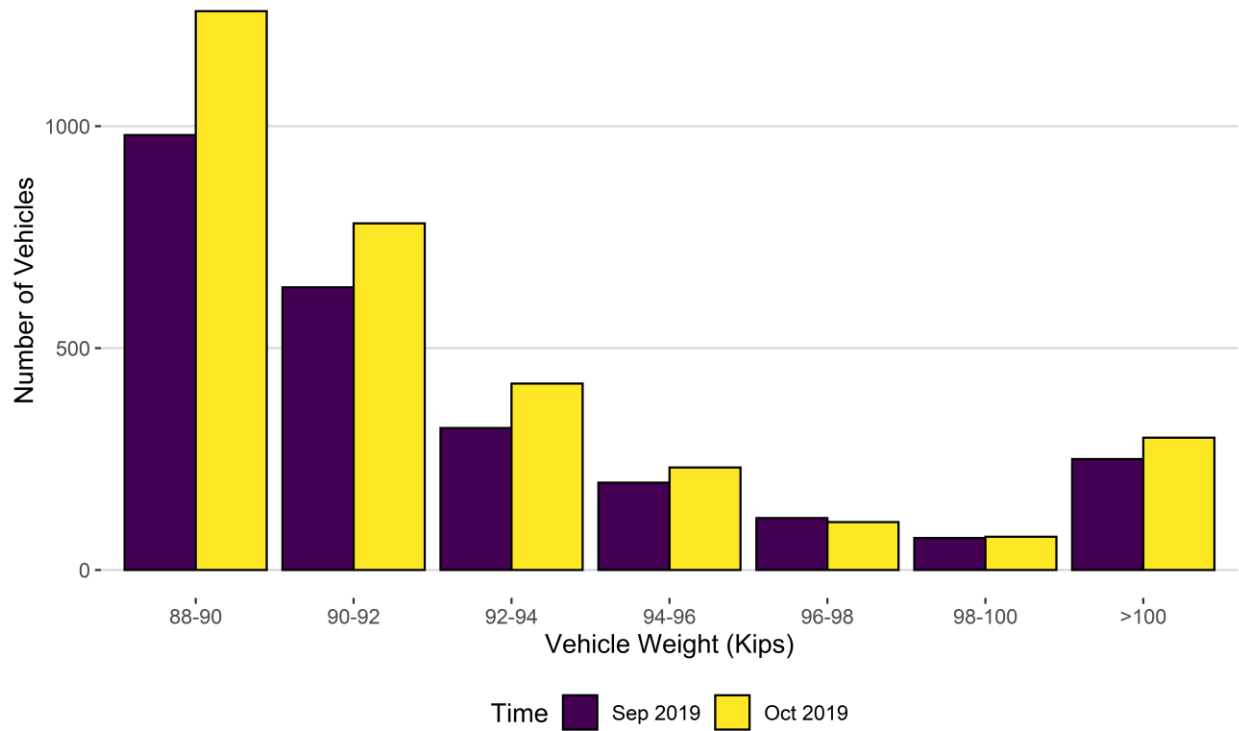


Figure 8 - Histogram of Vehicles Over 88,000 Pounds for Current Month



<i>Vehicle Weights (Kips)</i>	<i>Sep 2019</i>	<i>Oct 2019</i>
88-90	980	1259
90-92	637	781
92-94	320	420
94-96	197	231
96-98	117	108
98-100	72	75
>100	250	298
Total	2573	3172

Figure 8 - Class 9's and 10's by Direction
vs Gross Vehicle Weight

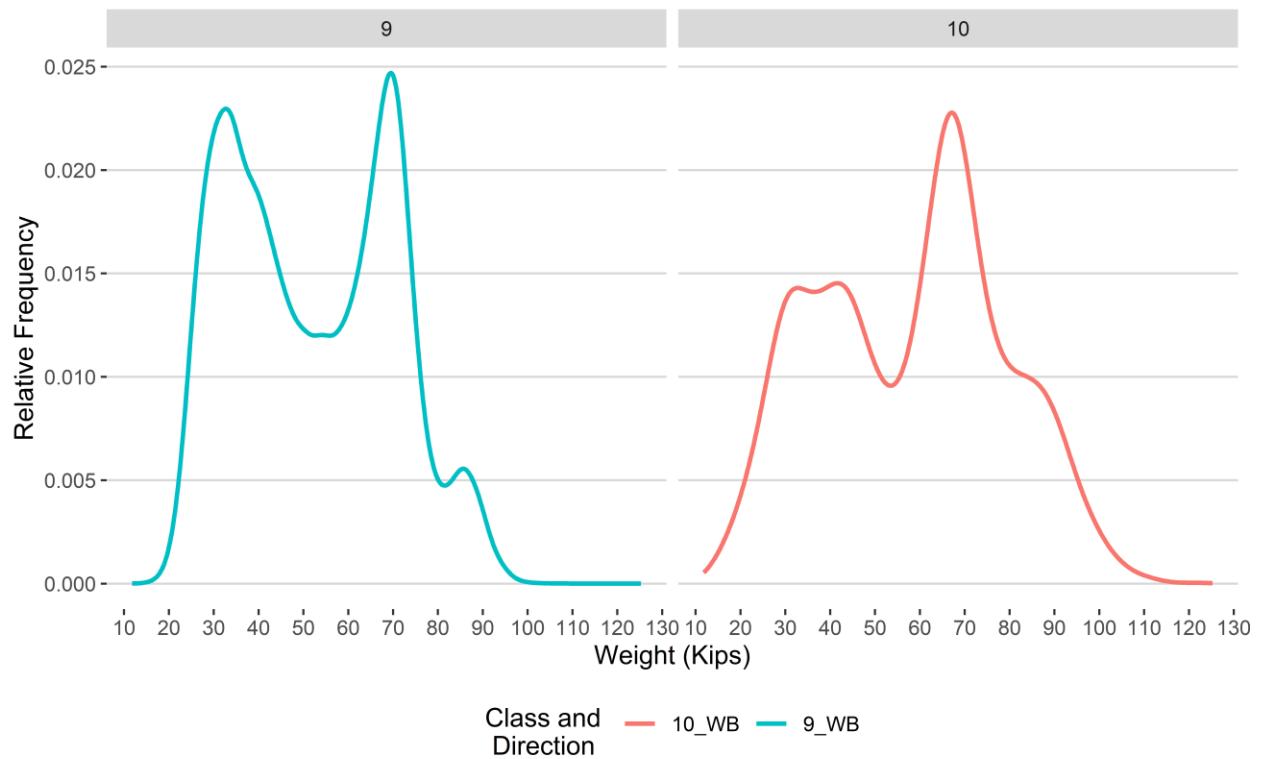


Figure 9 - Freight Percentage
by Direction and Class

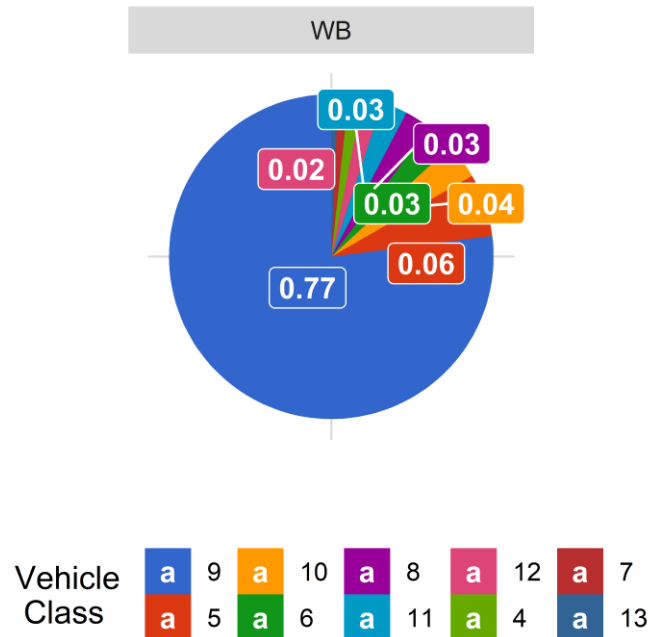


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

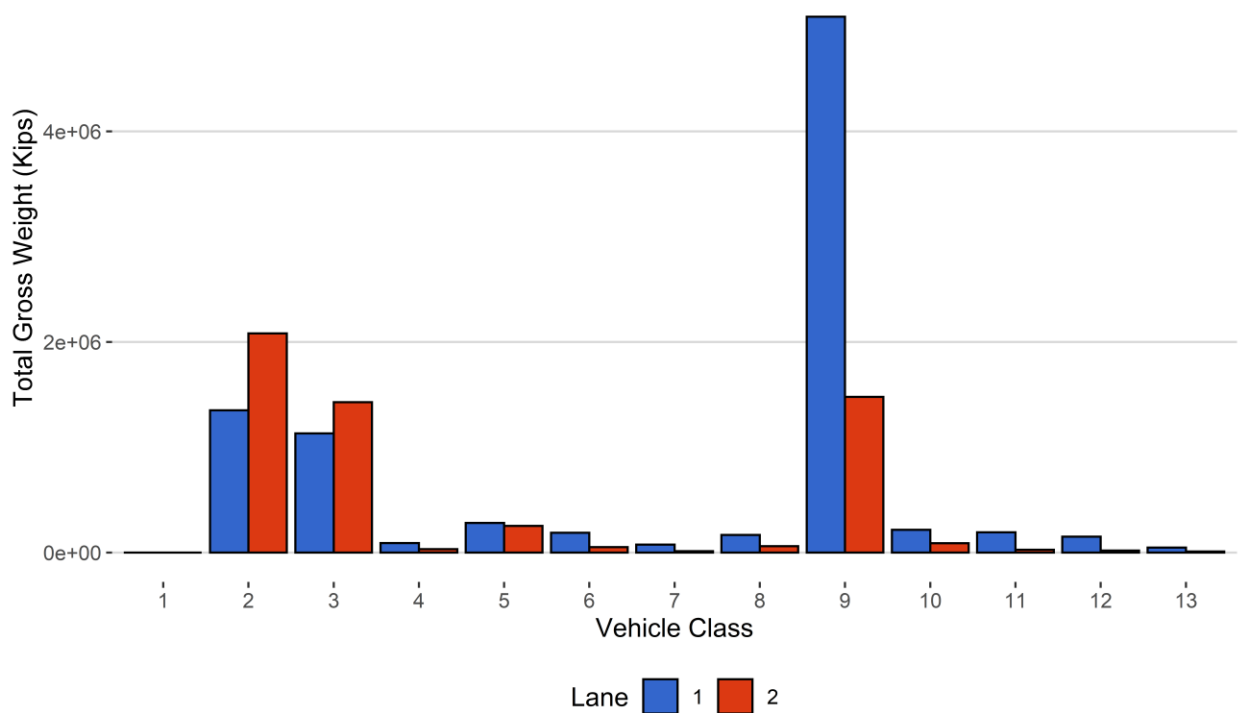


Figure 11 - Total Gross Vehicle Weight t

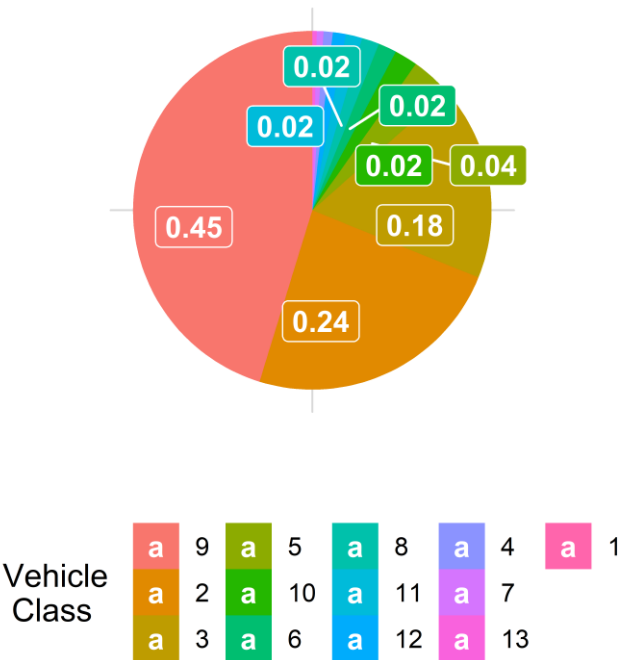


Figure 12 - Total ESALs by Class and Lane

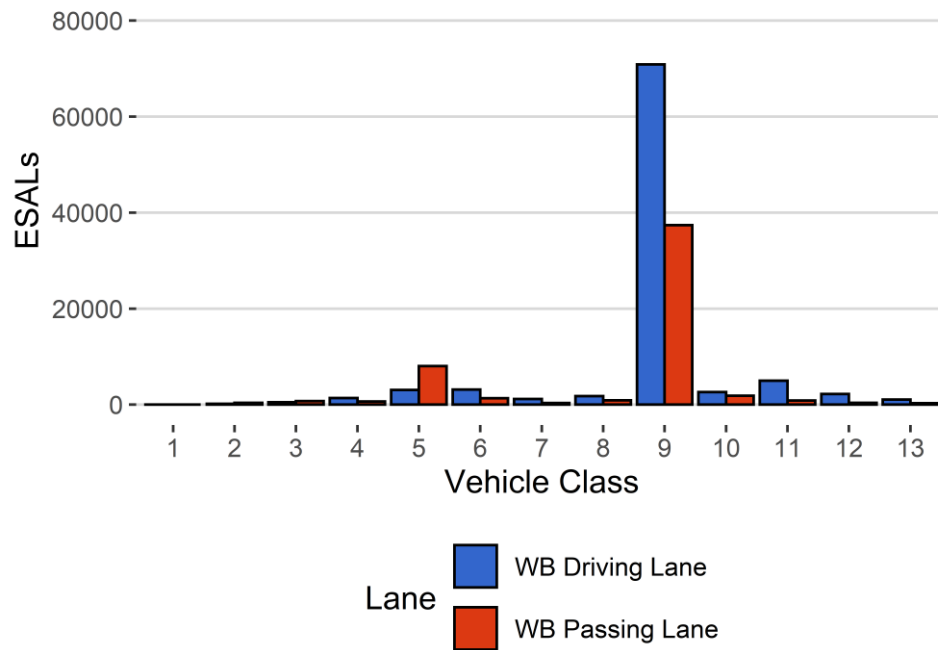


Figure 13 - ESALs by Class

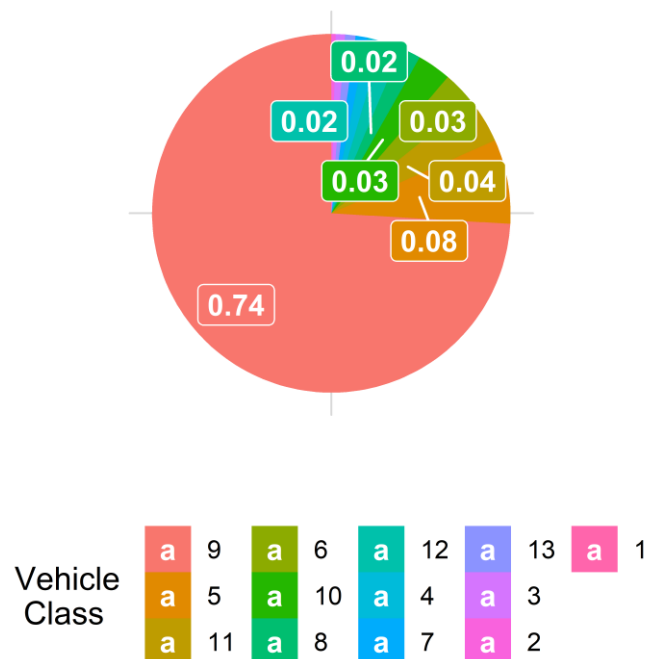


Table 1 Class 9 Front Axle Weight by Lane

<i>Month</i>	<i>Lane 1 (Kips)</i>	<i>Front Axle +/- 9%</i>	<i>Lane 2 (Kips)</i>	<i>Front Axle +/- 9%</i>
October 2015	NA	NA	12.62	0.00
November 2015	NA	NA	12.63	0.13
December 2015	NA	NA	12.95	2.61
January 2016	NA	NA	12.98	2.85
February 2016	NA	NA	13.01	3.09
March 2016	NA	NA	12.90	2.25
April 2016	NA	NA	12.79	1.38
May 2016	NA	NA	12.75	1.03
June 2016	NA	NA	12.70	0.61
July 2016	NA	NA	12.81	1.51
August 2016	NA	NA	12.19	-3.40
September 2016	10.50	0.00	12.21	-3.22
October 2016	10.48	-0.20	12.25	-2.92
November 2016	10.70	1.94	12.63	0.12
March 2017	10.57	0.70	13.54	7.27
April 2017	10.54	0.42	11.79	-6.60
May 2017	10.50	0.04	12.19	-3.41
June 2017	10.48	-0.19	11.90	-5.71
July 2017	10.45	-0.42	11.92	-5.51
August 2017	10.45	-0.47	12.01	-4.82
September 2017	10.52	0.16	11.86	-5.97
October 2017	10.53	0.30	12.02	-4.78
November 2017	10.54	0.42	12.84	1.79
December 2017	10.55	0.44	12.67	0.37
January 2018	10.54	0.36	12.69	0.55
February 2018	10.55	0.44	12.70	0.68
March 2018	10.55	0.45	12.51	-0.83
April 2018	10.45	-0.48	12.28	-2.69
May 2018	10.44	-0.57	11.98	-5.06
June 2018	10.48	-0.21	11.92	-5.52
July 2018	10.49	-0.06	12.02	-4.72
August 2018	10.54	0.35	12.03	-4.67
September 2018	10.52	0.24	12.23	-3.05
September 2019	10.49	-0.09	12.30	-2.55
October 2019	10.50	-0.01	12.33	-2.26

Table 2 Vehicle Classification Data

<i>Vehicle Class</i>	<i>Monthly Average Daily Volume</i>	<i>Monthly Total Volume</i>	<i>Monthly Total Volume Percentage</i>	<i>Monthly Total Overweight Vehicles</i>	<i>Monthly Total Overweight Percentage</i>
1	1	33	0	0	0
2	18902	585952	57.7	0	0
3	9006	279199	27.5	0	0
4	110	3401	0.3	234	1.5
5	922	28573	2.8	1003	6.4
6	189	5845	0.6	482	3.1
7	42	1290	0.1	192	1.2
8	187	5787	0.6	151	1
9	3122	96796	9.5	12094	76.7
10	130	4024	0.4	930	5.9
11	85	2642	0.3	203	1.3
12	66	2045	0.2	133	0.8
13	16	486	0	352	2.2
TOTAL	32777	1016074	100	15774	100

Table 3 Top 10 Gross Vehicle Weight, Class 9 and 10

<i>Date</i>	<i>Day of Week</i>	<i>Time</i>	<i>Vehicle Class</i>	<i>Direction</i>	<i>Lane</i>	<i>GVW (lbs)</i>
2019-10-19	Saturday	12:40:06	9	WB	1	125.28
2019-10-28	Monday	17:07:00	10	WB	2	123.68
2019-10-21	Monday	21:53:59	10	WB	2	122.81
2019-10-17	Thursday	03:36:20	10	WB	1	119.95
2019-10-10	Thursday	16:52:13	9	WB	1	117.67
2019-10-10	Thursday	16:52:13	9	WB	1	117.67
2019-10-18	Friday	10:20:33	10	WB	2	117.29
2019-10-04	Friday	11:47:28	10	WB	2	114.84
2019-10-04	Friday	11:47:28	10	WB	2	114.84
2019-10-07	Monday	20:17:11	10	WB	2	113.24

Table 4 Freight Summary

<i>Vehicle Class</i>	<i>Direction</i>	<i>Weight of Empty Vehicle (Kips)</i>	<i>Total Number of Vehicles</i>	<i>Number of Empty Vehicles</i>	<i>Percentage of Empty Vehicles</i>	<i>Total Weight of Vehicles with Freight (Kips)</i>	<i>Total Weight of Empty Vehicles (Kips)</i>	<i>Total Weight of Freight (Tons)</i>
4	WB	15	4426	613	13.8	113430	7891	28117
5	WB	8	37188	1884	5.1	519943	13490	118755
6	WB	19	7607	482	6.3	231043	8356	47834
7	WB	11.5	1679	1	0.1	88122	11	34413
8	WB	31	7532	4079	54.2	132922	94176	12939
9	WB	33	125980	24074	19.1	5883670	682498	1260386
10	WB	33.5	5237	827	15.8	281650	22558	66957
11	WB	36.5	3439	56	1.6	216278	1697	46400
12	WB	36.5	2662	22	0.8	167724	603	35682
13	WB	31.5	633	0	0	57097	0	18579
TOTAL	****	****	196383	32038	****	7691880	****	1670063

Table 5 Gross Vehicle Weight by Class and Lane

<i>Vehicle Class</i>	<i>WB Driving Lane</i>	<i>WB Passing Lane</i>	<i>Total</i>	<i>Percentage</i>
1	25	32	57	0
2	1350669	2081455	3432125	23.6
3	1130810	1427867	2558677	17.6
4	89207	32114	121321	0.8
5	281007	252426	533433	3.7
6	188000	51399	239399	1.6
7	74947	13186	88133	0.6
8	166379	60718	227097	1.6
9	5088775	1477393	6566168	45.2
10	215700	88507	304207	2.1
11	192078	25898	217976	1.5
12	149913	18414	168328	1.2
13	46846	10252	57097	0.4
TOTAL	8974356	5539662	14514018	100
GVW/LANE	61.83	38.17	100	0

Table 6 ESALs by Class and Lane and Flexible ESAL Factors

<i>Vehicle Class</i>	<i>WB Driving Lane</i>	<i>WB Passing Lane</i>	<i>Total</i>	<i>Percentage</i>	<i>Flexible ESAL Factor</i>
1	0	0	0	0	0.0227
2	171	396	567	0.4	0.0015
3	486	750	1236	0.8	0.0068
4	1386	652	2038	1.4	0.92
5	3082	8038	11120	7.6	0.6
6	3147	1328	4474	3.1	1.18
7	1193	329	1522	1	1.81
8	1769	900	2668	1.8	0.71
9	70858	37397	108255	74.1	1.72
10	2616	1842	4457	3	1.7
11	4995	857	5852	4	3.4
12	2236	372	2608	1.8	1.96
13	1059	304	1363	0.9	4.24
TOTAL	92996	53164	146160	100	18
ESALS/LANE	63.6	36.4	100	-	-

Table 7 Site Summary: Volume and Vehicle Class

<i>Month</i>	<i>Total Volume</i>	<i>Monthly ADT</i>	<i>Monthly HCADT</i>	<i>Passenger Vehicles</i>	<i>Passenger Vehicles %</i>	<i>Heavy Commercial Vehicles</i>	<i>Heavy Commercial Vehicles %</i>
Sep 2019	1008591	33620	4586	871021	86.4	137569.5	13.6
Oct 2019	1016074	32777	4867	865184	85.1	150890	14.9
TOTAL	2024665	-	-	1736205	-	288460	-
AVERAGE	1012332	33198	4726	868102	86	144230	14

###ESALs

<i>Month</i>	<i>ESALS WB Driving Lane</i>	<i>ESALS WB Passing Lane</i>	<i>Total ESALS</i>	<i>Pavement Life Decrease Months</i>
Sep 2019	57713	282452	340165	34.4
Oct 2019	93325	381848	475173	33.7
TOTAL	151038	-	-	-
AVERAGE	75519	332150	407669	34

###Gross Vehicle Weight

<i>Month</i>	<i>GVW WB Driving Lane</i>	<i>GVW WB Passing Lane</i>	<i>Total GVW Kips</i>
Sep 2019	5780096	4752543	10532640
Oct 2019	8992436	5775843	14768279
TOTAL	14772532	10528386	25300918
AVERAGE	7386266	5264193	12650459

###Overweight Vehicles

<i>Month</i>	<i>Total Number of Overweight Vehicles</i>	<i>Overweight / Total Volume</i>	<i>Overweight / Heavy Commercial Volume</i>	<i>Number Over 88,000 lbs</i>	<i>Number Over 98,000 lbs</i>
Sep 2019	15331	1.6	11.1	2659	388
Oct 2019	20027	1.5	9.9	3313	478
TOTAL	35358	-	-	5972	866
AVERAGE	17679	1.6	10.5	2986	433

###Freight

<i>Month</i>	<i>WB Freight Tons</i>
Sep 2019	1169417
Oct 2019	1670063
TOTAL	2839480
AVERAGE	1419739.8